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19 April 2010

VIA ELECTRONIC FILING
Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Notification of Ex Parte Presentation*
        PS Docket No. 06-229

Dear Ms. Dortch:

On Friday, April 16, 2010, Ken Budka, Tewfik Doumi, Wim Brouwer, Maria Palamara, Len Fatica, Paul Kenefick, Dan Johnson, Jim Freeburg, Konstantin Livanos and the undersigned of Alcatel-Lucent met Walter Johnson, Ziad Sleem, Peter Trachtenberg, Jennifer Salhus, Yoon Chang, Kurian Jacob, Behzad Ghaffari, Jordan Usdan, Saurbh Chohabra, Ahmed Lahjouji, and Jerome Stanshine of the Federal Communications Commission ("FCC/Commission"). During the meeting, the parties discussed "the minimum requirements necessary to allow localities and regions to build out local systems as part of the 700 MHz nationwide, interoperable wireless broadband public safety network."[1]

Most notably, Alcatel-Lucent urged the Commission to expeditiously move forward on the pending waiver petitions. In addition, we are supportive of both the Public Safety Spectrum Trust's recommendations and the substance of the National Public Safety Telecommunications Council Broadband Task Force ("BBTF") report, but it is important for the Commission to adopt only those recommendations that foster meaningful *and* prompt deployment in the short term. Not all steps are necessary at the initial stage of launch and operations and, in fact, implementing some requirements could be premature and counter-productive at this time.

We recommended that the Commission condition its grant of 700 MHz public safety waivers on implementation of those recommendations that, as a general matter, relate to provision of basic Long Term Evolution ("LTE") broadband data and IP access services. This approach will ensure a sufficient beachhead for 700 MHz public safety LTE requirements, including network interoperability, and provide immediate benefits for public safety data applications, while leaving time for upper layer application interoperability requirements to mature.

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[1] *See* Public Notice, *Comment Sought on NPSTC Broadband Task Force and Public Safety Spectrum Trust Technical Recommendations for 700 MHz Public Safety Broadband Deployments*, WT Docket No. 06-150, PS Docket No. 06-229, DA 10-458 (PSHSB rel. Mar. 17, 2010) ("Public Notice").

The initial requirements can be supplemented as relevant technical and interoperability standards are resolved in the future, particularly at the application level and with respect to priority access. Indeed, the BBTF's recommendations, by their terms, acknowledge several open issues and matters for future study. The recommendations thus serve as an important and pragmatic starting point for developing longer term interoperability standards, but also recognize that additional detail-level work is necessary to meet the Commission's ultimate objectives.

Further, Alcatel-Lucent is currently testing and field trialling LTE infrastructure with 8 different device vendors in 7 different 3GPP standard spectrum bands in both FDD and TDD modes with near term plans for several more spectrum bands and device manufacturers. We are ramping up manufacturing and production to support significant deployment volumes this year with multiple operators. In fact, we are currently shipping LTE eNodeBs to commercial customers, such as Verizon Wireless who has publicly announced their plans to begin offering commercial LTE service in several markets in the United States before the end of 2010.

Alcatel-Lucent is currently planning to support LTE trials in band class 14 in the 4Q10, and will be ready to deploy in the band first quarter of 2011. This timeframe, however, is dependent on timely availability of user equipment, granting of the waiver requests by mid-summer or earlier, and a clear understanding of regulatory constraints for early deployments. The product hardware is being designed to be compatible with the entire band class 14, which includes the D and the public safety broadband block ("PSBB"). Our initial solution supports operation in the 2x5 MHz Public Safety Broadband Block as contemplated by waiver applicants. Moreover, jurisdictions whose waiver requests have been granted by the FCC can immediately begin network engineering, site prep and deployment of their backhaul networks, while waiting for the LTE band class 14 eNodeBs. Thus, allowing the jurisdiction to be fully operational by early 2011.

In regards to devices, we team with at least one vendor approximately four months prior to eNodeB product availability in a new spectrum band, which allows for complete product testing in that spectrum band. After development testing is complete, we then begin additional device interoperability testing (IOT). For device vendors with which we have already conducted IOT in a different spectrum band, interoperability validation in the new spectrum band can typically be achieved in a few weeks. With a completely new device vendor, this interval can vary widely depending on the device vendor's LTE knowledge and level of experience.

Moreover, LTE standards are well defined in 3GPP Release 8 and support multi-vendor network deployments, inter-vendor roaming and handoff, and inter-operator roaming. We have conducted IOT of our eNodeB and Evolved Packet Core products with multiple vendors' network equipment (at various levels of functionality) on key interfaces, as defined in the 3GPP standards. We are also working with many commercial operators that are planning LTE networks, who currently expect to deploy multi-vendor networks. Today, we are actively working with these commercial operators and their other infrastructure vendors to support interoperability requirements. In addition, Alcatel-Lucent provides a complete end-to-end LTE product and services solution based on open 3GPP standards that can significantly reduce the amount of integration planning and effort that would be required to deploy a multivendor network. Our solution includes products from key partners for devices and other network elements that we do not manufacture ourselves.

Finally, there is overwhelming unanimity amongst all public safety agencies and associations that the technology of choice should be LTE. APCO International, the National Emergency Numbering Association, the Public Safety Spectrum Trust, and the National Public Safety Telecommunications Council have all publicly endorsed LTE for use in the public safety 700 MHz spectrum space. We encourage the FCC to definitively state that LTE is the public safety technology that will be deployed in the PSBB. The FCC should not choose an interim technology and have public safety customers suffer the pain and cost of stranded infrastructure and device investment, which will in the end require a spectrum transition period with network downtime.

For instance, a network deployment of HSPA requires a full 2x5 MHz spectrum band and cannot coexist with LTE in the same spectrum band. Since the Public Safety Broadband spectrum space currently allocated is 2x5 MHz, the HSPA network would have to be shut down completely in order for LTE to be activated, resulting in significant network downtime in order to facilitate LTE network integration and testing. This would deny public safety access to their mission critical broadband network and applications. In addition, new devices will most likely be required for the LTE network and it is highly unlikely that user devices will be capable of providing both HSPA and LTE in the same band from multiple device vendors in substantial volumes. In the end, a limited network and device ecosystem would defeat the purpose of a cost-effective, interoperable, and open broadband standard. Further, we believe that an HSPA ecosystem for the PSBB will be unlikely to emerge and in the end would not allow public safety to take advantage of the "economies of scale" that LTE deployments in the 700 MHz band would provide.

In accordance with Section 1.1206(b) of the Commission's rules, this letter is being filed electronically with your office, along with the attached presentation used at the meeting. Please contact the undersigned if you have any questions.

Sincerely,

Michael McMenamin

cc: Walter Johnson
Ziad Sleem
Peter Trachtenberg
Jennifer Salhus
Yoon Chang
Kurian Jacob
Behzad Ghaffari
Jordan Usdan
Saurbh Chohabra
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Jerome Stanshine
Jennifer Manner

Broadband Public Safety & Long Term Evolution

April 16, 2010

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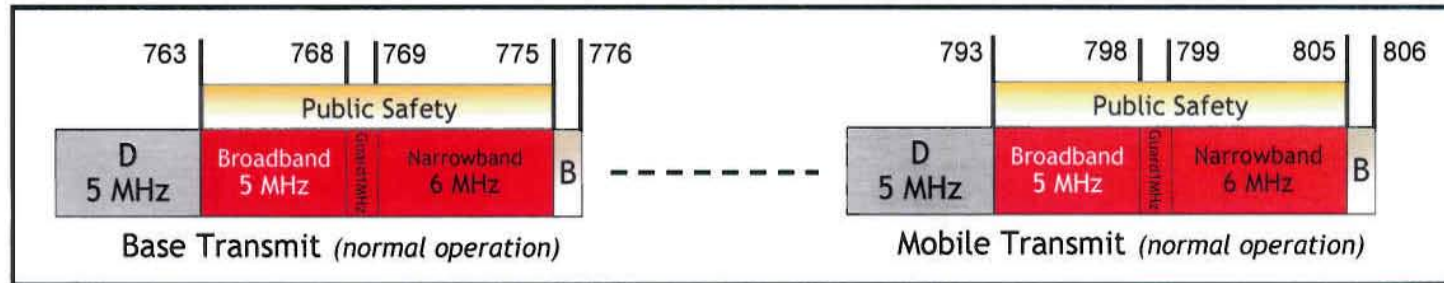Long Term Evolution and Public Safety 700 MHz

Roaming

Quality of Service

Priority Services

Standards Status

Summary

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Long Term Evolution & Public Safety 700 MHz

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Public Safety Broadband Spectrum

Base Transmit *(normal operation)*   Mobile Transmit *(normal operation)*

A single 5 MHz-wide <u>interoperability</u> channel is available

Fragmenting the single block into narrower channels, e.g. 1.4 or 3 MHz, yields a poorer spectral efficiency

The use of a legacy technology, e.g. UMTS/HSPA, leads to

- Complex and costly technology migration without additional spectrum

- Costly device upgrades

Record and market forces indicate a wide support for Long Term Evolution

- The National Broadband Plan, among other stakeholders, suggests that LTE be mandated

The selection of a common standard like LTE is an essential pre-requisite for achieving Interoperability

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On Interoperability and what the Record Indicates

"We, as an initial matter, continue to believe that if interoperability is to be achieved on the Interoperability channels, a single standard must be selected to ensure equipment compatibility. Based on our review of the record in this proceeding, we conclude that the Project 25 Phase I standard should be the single narrowband digital voice standard for the Interoperability channels at this time, as recommended by the NCC..." *FCC FOURTH REPORT AND ORDER AND FIFTH NOTICE OF PROPOSED RULEMAKING, WT No.96-86, January 2001*

Note: P25 was recommended by the National Coordination Committee (NCC) on the basis of reviews of the Common Air Interface standard specifications

"We believe the rules governing interoperability channels should be similar for wideband and narrowband mobile and portable radios. Therefore, we tentatively conclude that the rules should be amended to require wideband mobile and portable radios to be capable of operating on all the wideband interoperability channels using the TIA-902 (SAM) standard..." *FCC FIFTH MEMORANDUM OPINION AND ORDER, SIXTH REPORT AND ORDER, AND SEVENTH NOTICE OF PROPOSED RULEMAKING, WT no.96-86, January 2005*

Note: TIA-902 (SAM) was also recommended by NCC on the basis of a review of the air-interface specification only

Mandating a Technology when Interoperability is a Critical Decision Factor is not without Precedent

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Interoperable Broadband Network

The (nationwide) interoperable broadband public safety network is a network, or a collection of networks which, as designed/manufactured by one or more entities around a common set of Standardized technical specifications, will allow cross-discipline communications to/from authorized radio terminals

As it applies to public safety, by means of a **single radio terminal**, the ability to

- Get on the network regardless of jurisdiction or current location (i.e. roaming)

- Access a minimal set of applications when in a visited jurisdiction

- (ultimately) Roam onto a non-public safety network

Keeping in mind that

- Visiting users may be treated differently priority-wise and from a quality of service perspective than at home users

- Security mechanisms and policies may differ in the visited network

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LTE Standard Network Architecture

Policy & Charging Rule Function
- Network control of Service Data Flow (SDF) detection, gating, QoS & flow based charging
- Dynamic policy decision on service data flow treatment in the PCEF (PGW)
- Authorizes QoS resources
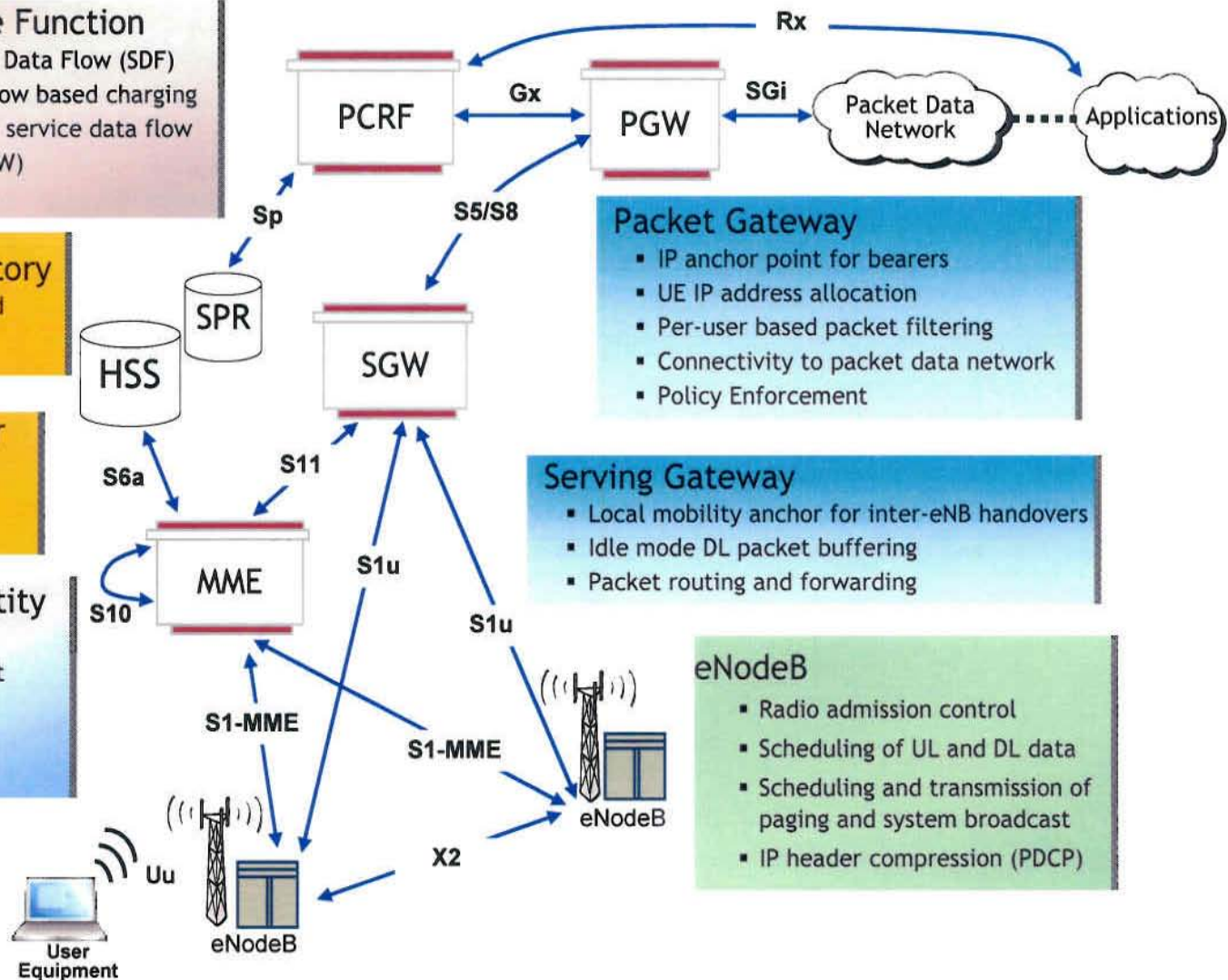
Subscriber Profile Repository
- Subscription data for policy and charging

Home Subscriber Server
- UE Authentication
- User subscription data
- Location Tracking

Mobility Management Entity
- Authentication
- Tracking area list management
- Idle mode UE reachability
- S-GW/PDN-GW selection
- Bearer management functions

Packet Gateway
- IP anchor point for bearers
- UE IP address allocation
- Per-user based packet filtering
- Connectivity to packet data network
- Policy Enforcement

Serving Gateway
- Local mobility anchor for inter-eNB handovers
- Idle mode DL packet buffering
- Packet routing and forwarding

eNodeB
- Radio admission control
- Scheduling of UL and DL data
- Scheduling and transmission of paging and system broadcast
- IP header compression (PDCP)

Rx

PCRF — Gx — PGW — SGi — Packet Data Network ..... Applications

Sp   S5/S8

SPR   SGW

HSS

S6a   S11

MME   S1u

S10   S1u

S1-MME

S1-MME

Uu   S1-MME   X2

User Equipment   eNodeB   eNodeB

*evolved Multimedia Broadcast Multicast Service (eMBMS) and Charging functions omitted for simplicity

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LTE, a Fundamental Interoperability Enabler

Equipment Interoperability

- LTE is developed under the auspices of an international standardization body with broad representation of vendors and operators

- **Equipment interoperability is a de-facto objective** at the outset

- The LTE SAE Trials Initiative (LSTI) is a group driven by leading infrastructure suppliers and operators

  - Both Key Performance Indicators (KPIs) and Interoperability Test cases are defined. Main focus is on End-to-End testing

- The Network Vendors Interoperability Testing (NVIOT) Forum is a group of leading equipment suppliers

  - The group's intent is to ensure that their equipment/solutions will **interoperate** from the very beginning, and therefore enable rapid establishment of **multi-vendor networks**

Roaming Interoperability

- Connectivity outside home networks

Applications Interoperability (i.e. cross-discipline, cross-regions)

- Driven by inter-jurisdictions agreements, governance, 'local' policies and procedures

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ROAMING

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Roaming Background

Roaming definition

- In the absence of coverage/service from the home network, provides the ability for the UE to scan supported radio bands, select a cell, and be authorized to attach on a visited network
- After authentication on visited network and assignment of an IP address, has the ability to initiate and receive communications services
- For purposes of mutual aid – may include access to visited network applications

Standard procedure for most commercial operators (dedicated staff and resources)

- Interworking involves key elements in commercial operators' networks
- Careful, well-planned approach

Types of roaming for Public Safety users

- Intra-system*: among Public Safety networks (e.g. NYC user in Seattle)
- Inter-system: with commercial service providers

*Using NPSTC-BBTF terminology, intra-system refers to communications within the public safety domain, i.e. non-commercial

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Roaming – Key Topics

Two key topics discussed by the National Public Safety Telecommunications Council's Broadband Task Force

- Public Land Mobile Network id's – Mobile Country Code (MCC) + Mobile Network Code (MNC)
  - Allocation of International Mobile Subscriber Identities (IMSI's) for devices
  - Primary tool to differentiate network of a user (access, accounting/billing, etc.)
- Use of a Roaming Broker
  - Simplify operations for Public Safety (fewer interfaces to manage)
  - Leverage existing technology, resources

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Roaming – Technical Considerations

Roaming agreement between operators involves:
- HSS, PCRF, & PGW vendors to assure interoperability
- Use of broker (e.g., Syniverse/Verisign) – impacts connectivity (where & how)
- IP Transport (e.g. routing protocol, ...)
- Domain Name System (DNS) services
- Interoperability testing

Agreement with broker (signaling and/or data):
- Points of interconnect
- Protocols, services included
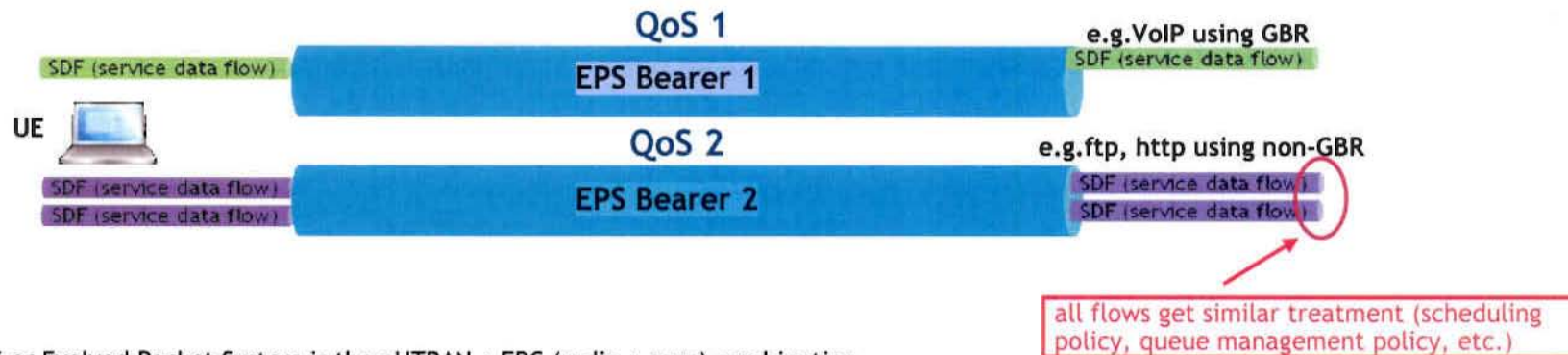- Charging agreement

Device planning/configuration:
- Visited Public Land Mobile Network (VPLMN) id list
- Universal Subscriber Identity Module (USIM) management
- Device management scheme

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QUALITY OF SERVICE

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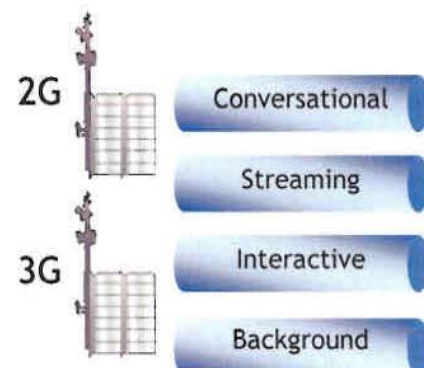
Evolved Packet System QoS Parameters

Per bearer (or bearer aggregate) QoS parameters

- QoS Class Identifier (QCI)
  - To control packet forwarding treatment (e.g. scheduling weights, admission thresholds, queue management thresholds, link layer protocol configuration, etc.), and typically pre-configured by the operator
- Allocation and Retention Priority (ARP) ← *For admission control, i.e. not used by eNodeB scheduler*
  - The primary purpose or ARP is to decide if a bearer establishment/modification request can be accepted or rejected in case of resource limitation
- Maximum Bit Rate (MBR) – Per GBR bearer
- Aggregate Maximum Bit Rate (AMBR) – Sums all non-GBR bearers per terminal/Access Point Name (APN)

QoS 1 — e.g.VoIP using GBR
SDF (service data flow) — EPS Bearer 1 — SDF (service data flow)

UE

QoS 2 — e.g.ftp, http using non-GBR
SDF (service data flow) / SDF (service data flow) — EPS Bearer 2 — SDF (service data flow) / SDF (service data flow)

all flows get similar treatment (scheduling policy, queue management policy, etc.)

*EPS or Evolved Packet System is the eUTRAN + EPC (radio + core) combination

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QoS Standardized QCI Characteristics*

SDF priorities

Maximum between PCEF and UE

QCI	Resource Type	Priority	Packet Delay Budget	Packet Error Loss Rate	Example Services
1	GBR	2	100 ms	10-2	Conversational voice
2	GBR	4	150 ms	10-3	Conversational video (live streaming)
3	GBR	3	50 ms	10-3	Real-time gaming
4	GBR	5	300 ms	10-6	Non-conversational video (buffered streaming)
5	Non-GBR	1	100 ms	10-6	IMS signaling
6	Non-GBR	6	300 ms	10-6	Video (buffered streaming) TCP-based (e.g., www, email, chat, ftp, p2p file sharing, progressive video, etc.)
7	Non-GBR	7	100 ms	10-3	Voice, video (live streaming), interactive gaming
8	Non-GBR	8	300 ms	10-6	"Premium bearer" for video (buffered streaming) TCP-based (e.g., www, email, chat, ftp, p2p file sharing, progressive video, etc.) for premium subscribers
9	Non-GBR	9			"Default bearer" for video TCP-based services, etc. for non-privileged subscribers

2G
- Conversational
- Streaming

3G
- Interactive
- Background

From: 4 classes in UMTS and CDMA

To: **9 classes (QCI) in LTE**

*Standardizing QCI characteristics ensures minimum level of QoS for mapped applications e.g. in case of roaming or with multi-vendor equipment

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PRIORITY SERVICES

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Capabilities Supporting "Priority Treatment"

Air interface

- Access Class Barring
  - Cell broadcasts allowed classes and % allowed
- RRCConnectionRequest ("*highpriority*")*
  - Establishment Cause
  - Paging Cause (proposed by NGN GETS)

Admission control (resource limitations)

- ARP (Allocation & Retention Priority)
  - Allocation of bandwidth by GBR/NGBR and priority level
  - Pre-emption

Packet treatment

- QCI for default bearer (e.g. QCI=8 for Public Safety or NGN GETS, QCI=9 for standard users)
  - May be modified by PCRF depending on service carried

*RRC Connection Request is one of many signaling messages exchanged between a UE and the network

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Differences between NGN GETS and PS Priority Access

NGN GETS

- Applies to <u>commercial networks</u>
- <u>Pre-emption is not allowed</u>. In congestion situations, higher priority users are given priority treatment, e.g. by queuing requests until resources are available
- Typically, there is <u>no differentiation between at home and visiting GETS</u> users
- Static priority for a NGN GETS user – stored in HLR/HSS (can be overridden by PCRF rules)

Public Safety Networks (per NPSTC-Broadband Task Force)

- <u>Networks built primarily for 1st responders and Public Safety support</u>
- <u>Pre-emption allowed</u>
- Public Safety requires 3 groups of users: 1st responders, direct support to 1st responders, other support
- <u>Public Safety requires differentiation between at home and visitors</u> at the jurisdiction level
- <u>Need ability to change priority in real time</u> – by incident commander

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Access Class Barring - Priority Access in LTE

What is it?

- Mechanism to discourage regular users from accessing a cell
- Typical use:
  - Reserve cells for operator activities – maintenance, growth, etc.
  - Reduce access overload in time of emergency

Access control using access classes:

- Access class stored in USIM of device
  - Classes 0-9 random assigned to commercial users
  - Class 10 -> E911 calls
  - Classes 11 & 15 are reserved for network administrative devices
  - Remaining classes for Public Safety & NGN GETS users
    - Class 12 – Security Services (police, …)
    - Class 13 – Public Utilities ((water, gas, …)
    - Class 14 – Emergency Services (fire, EMT, ..)
- eNodeB controls user access via broadcast access barring parameters in SIB2 and UE performs actions according its stored Access Class
  - If member of allowed class (10-15), access eNB
  - If in class 0-9, run persistent test before access
    - Access eNodeB only if persistent test passes

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Allocation Retention Priority (ARP) - Call Admission Control

ARP is stored in the Subscriber profile (HSS) on a per APN basis (at least one APN must be defined per subscriber)

- Priority level: 1 – 15, with 1-8 intended for prioritized treatment within operator domain (per 3GPP 29.212, Section 5.3.45)
  - NGN GETS recommends reserving 1 to 5 ARP levels in the range of 1-8 to represent the 5 NGN GETS priority levels
- Pre-emption capability flag: can pre-empt other users
- Pre-emption vulnerability flag: can be pre-empted by other users

At every Radio Bearer (RB) setup request (including HO and RRC connection re-establishment), the eNodeB Radio Admission Control (RAC) entity checks the current eNodeB's ability to accept the request, considering factors such as:

- Maximum number of UEs and RBs
- Number of RBs on GBR
- Hard capacity limit

ARP controls how the eNodeB reacts when there are insufficient resources to establish the new RB (includes handover requests)

- Deny the RB request
- Preempt an existing RB and accept the new RB request

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Proposed User Priority by NGN GETS [in CDMA WPS and NGN GETS]

Priority Level	Responsibility	Qualifying Criteria
1	Executive Leadership and Policy Makers	A limited number of Service Provider technicians who are essential to restoring the Service Provider networks may also receive this highest priority treatment.
2	Disaster Response / Military Command and Control	Individuals eligible for Priority 2 include personnel key to managing the initial response to an emergency at the local, State, regional and Federal levels. Personnel selected for this priority should be responsible for ensuring the viability or reconstruction of the basic infrastructure in an emergency area. In addition, personnel essential to the continuity of government and national security functions (e.g., conducting international affairs and intelligence activities) are included.
3	Public Health, Safety, and Law Enforcement Command	Eligible for this priority are individuals who direct operations critical to life, property, and maintenance of law and order immediately following an event. (Police, Fire, EMS, ...)
4	Public Services/Utilities and Public Welfare	Eligible for this priority are those users whose responsibilities include managing public works and utility infrastructure damage assessment and restoration efforts and transportation to accomplish emergency response activities. (Electricity, Gas, ...)
5	Disaster Recovery	Eligible for this priority are those individuals responsible for managing a variety of recovery operations after the initial response has been accomplished. (FEMA, Red Cross, Salvation Army

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STANDARDS - STATUS

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LTE Standards Evolution Highlights

Release 8	Release 9 *Just finalized*	Release 10 *Currently Under Study*
• All-IP Architecture • Support of LTE, legacy 3GPP and non-3GPP technologies • LTE radio access network & core network support • Priority services for voice and data • Circuit-switch fallback • Voice over IMS • Handover to non-3GPP technologies • ...	• Support for IMS-based emergency calls • IMS Centralized Services • LTE Location Services • enhanced Multimedia Broadcast Multicast (eMBMS) support (core - broadcast) • Enhanced Home NodeB • Self-organizing networks (study) • ...	• enhanced Mobile Priority Service (eMPS) • Multicast support in eMBMS • Advanced interference mitigation techniques • Network improvements for Machine-to-machine communications • Support large number of always-on terminals • Relays • ...
LTE Initial Introduction Focus: Higher speed data Interop with legacy technologies deployed by service providers	**Incremental Improvement** Focus: Convergence (Voice, video, data on common network)	**"LTE Advanced"** Focus: Incremental improvements, Higher Capacity (small cells)

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Summary

LTE is designed from the ground up as an interoperable technology

Roaming is a fundamental capability in LTE

LTE standards provide advanced QoS and Priority mechanisms ideally suited to public safety needs

Alcatel-Lucent Recommended phasing of functionality for Public Safety LTE use of 700 MHz Public Safety Broadband spectrum:

1. Basic broadband data on day one

2. Add priority services when needed and interoperability and governance/policy rules are clear and well-defined

3. Add advanced application interoperability when requirements are clear, e.g voice services, LMR interworking, etc.

Grant waivers: The need is now, real-world experience gained invaluable to creating an interoperable broadband network for public safety

LTE is the most appropriate technology for Public Safety 700 MHz broadband data services

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Glossary

3GPP	Third-Generation Partnership Program	**NGN**	Next-Generation Network
AMBR	Aggregate Maximum Bit Rate	**NVIOT**	Network Vendors Interoperability Testing
ARP	Allocation & Retention Priority	**OFDMA**	Orthogonal Frequency-Division Multiple Access
ASME	Assets Security Management Entity	**PCRF**	Policy & Charging Rules Function
AuC	Authentication Center	**P-GW**	Packet Data Gateway
eNB	eNode-B (Base station)	**PS**	Public Safety
EPC	Evolved Packet Core	**PSBB**	Public Safety Broadband
EPS	Evolved Packet System	**PSNB**	Public Safety Narrowband
FDD	Frequency-Division Duplex	**QCI**	QoS Class identifier
GBR	Guaranteed Bit Rate	**QoS**	Quality of Service
GETS	Government Emergency Telecommunications Service	**RB**	Radio Access Bearer
HO	Handover	**RAC**	Radio Admission Control
HSS	Home Subscriber Server	**RRC**	Radio Resource Control
IMS	IP Multimedia Services	**SAE**	System Architecture Evolution
KPI	Key Performance Indicator	**SC-FDMA**	Single-Carrier Frequency Division Multiple Access
LSTI	LTE/SAE Trial Initiative	**SDF**	Service Data Flow
LTE	Long Term Evolution	**S-GW**	Serving Gateway
MBR	Maximum Bit Rate	**SIB**	System Information Block
MCC	Mobile Country Code	**TDD**	Time-Division Duplex
MIMO	Multiple-Input Multiple-Output	**UE**	User Equipment
MNC	Mobile Network Code	**UICC**	Universal Integrated Circuit Card
MME	Mobility Management Entity	**USIM**	Universal Subscriber Identity Module

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